(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 248 660**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: 87304933.2

(22) Date of filing: 03.06.87

(51) Int. Cl.⁴: **B 21 F 27/16**

(30) Priority: 04.06.86 GB 8613558
04.06.86 GB 8613559

(43) Date of publication of application:
09.12.87 Bulletin 87/50

(84) Designated Contracting States:
AT BE CH DE ES FR GB GR IT LI LU NL SE

(71) Applicant: Multilastic Limited
134 High Street
Brierley Hill West Midlands (GB)

(72) Inventor: Holland, Lawrence
1, Bowerfield Avenue Hazel Grove
Stockport Cheshire (GB)

(74) Representative: Wallbank, Roger Wickham et al
BARKER, BRETTELL & DUNCAN 138 Hagley Road
Edgbaston Birmingham, B16 9PW (GB)

(54) **The manufacture of spring units.**

(57) In a known method of making spring units for use in mattresses, etc., a plurality of spring bands (7, 8, 9) are disposed side by side and linked together by transverse helical wires (6A, 6B) to form a length of spring unit which is subsequently divided transversely to form individual units. Each spring band is made from a length of wire bent to form a row of coil springs (1), each of which is integrally connected to the next by a connector (2). Each connector has spaced end portions (3) extending transversely of the band and an intermediate portion (4) extending past the two springs it interconnects. The helical wires (6A, 6B) lie in main faces of the unit and embrace the end portions (3). In effecting division, a helical wire is omitted or removed from one main face, and the adjacent connectors in the other main face are severed. To enable the severed connectors to be attached to a peripheral frame (11; 116), the intermediate portions (4) to be severed are first to provide transversely extending central parts (109) which are shaped and severed to provide attachment portions (113) provided with stops (114) to prevent detachme.nt from the frame.

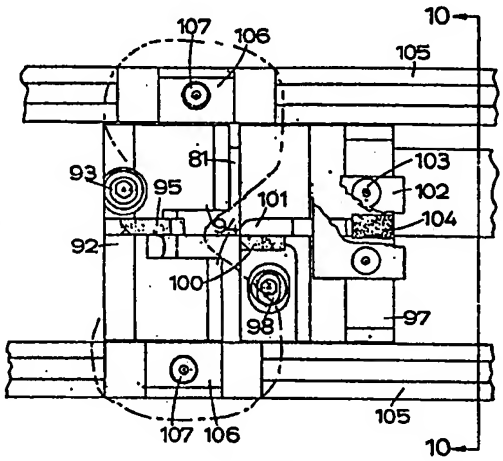

FIG.8.

EP 0 248 660 A1

Description

THE MANUFACTURE OF SPRING UNITS

This invention relates to the manufacture of spring units. Spring units can be incorporated in mattresses, seats, cushions and other products.

The invention is particularly concerned with spring units comprising an assembly of spring bands and helical wires. Each of the spring bands is of a known kind (hereinafter referred to as a spring band of the kind specified) comprising a length of wire bent so as to form a plurality of coil springs disposed side by side in a row, ends of the coil springs lying in or near opposed edge faces of the band, and a plurality of connectors integral with the springs, each such connector lying in or near an edge face of the band and serving to interconnect two adjacent springs in the row, and each connector having two spaced end portions extending transversely of the band with an intermediate portion between them, the intermediate portion extending past said two adjacent springs.

Spring bands of the kind specified can be assembled together to form a spring unit of a known kind (hereinafter referred to as a spring unit of the kind specified) comprising a plurality of spring bands, each of the kind specified, disposed side by side so that their edge faces lie in or near main faces of the unit, and a plurality of helical wires, some lying in or near one of said main faces and others lying in or near the other of said main faces and each helical wire embracing component portions of each band, namely two adjacent end portions of two neighbouring connectors.

The manufacture of one design of spring band of the kind specified is described and illustrated in the complete specification of British patent No. 937 644 granted to Willi Gerstorfer, and a method of assembling spring bands of that design with helical wires to form a spring unit of the kind specified, and one form of apparatus for carrying out that assembly, are described and illustrated in the complete specification of British patent No. 1 095 980 granted to Multilastic Limited.

The apparatus is of the kind (hereinafter referred to as the kind specified) comprising means for guiding and intermittently feeding a plurality of spring bands of the kind specified past a linking station, locating means at the linking station operative to engage the end portions of the connectors that are to be linked together, and drive means at the linking station for causing a helical wire to be rotated and moved axially, in the manner of a screw, across the bands so as to link the end portions together.

Assembly apparatus of the kind specified is capable of linking together relatively long spring bands so as to make a length of spring unit of indefinite extent. It is preferred, however, to provide means enabling individual spring units to be divided from a length of spring unit as the length is formed. Methods and apparatus for this purpose are described and illustrated in the complete specifications of British patent Nos. 1 104 884 and 1 183 315, each granted to Multilastic Limited. In each instance, a helical wire is omitted or removed from one main face of a length of spring unit, and the connectors of the spring bands in the other main face, immediately opposite to the place from which the helical wire is absent, are severed so as to divide them into two equal parts.

To add strength to the marginal parts of a spring unit of the kind specified it is usual to provide a peripheral frame, made of resilient metal strip, extending round the periphery of each of the main faces of the unit and to attach adjacent parts of the unit to the frame.

The frames can be attached to adjacent parts of the spring unit in any of a number of ways, For example, at intervals around each frame a short strip of metal may be wrapped around the frame and around an adjacent portion of wire constituting part of the spring unit so that that portion of wire is permanently held against the frame. Along each of the two sides of a unit, the connectors extend immediately adjacent to the frames, so they can readily be attached to the frames in this manner or in some similar manner. Greater problems arise, however, at the end of a spring unit.

As explained above, it is usual to form ends of spring units by omitting or removing a helical wire from one main face of a length of assembled spring bands and severing the middle of the adjacent connectors in the other main face. In this way the length can be divided into two, and adjacent end faces of the two parts become end faces of two spring units. When this is done, each end face of each unit must in some way be attached to adjacent parts of the peripheral frames. In a spring unit that has been divided from a length of spring unit in the manner described above, end portions of connectors lie immediately adjacent to one of the frames and can readily be attached to that frame with the aid of short strips of metal or the like wound around the frame and the end portions of the connectors as described above. Those end portions at the end of the unit are, of course, the end portions from which a helical wire was previously omitted or removed. The ends of the other frame, however, are not normally adjacent to any component wires of the end faces of the spring unit to which it can be attached in such a manner. Various expedients have been adopted to overcome this problem. For example, in the complete specification of British patent No. 1 207 717, granted to Multilastic Limited, there is described and illustrated a method of enlarging a loop of the end coil spring, at the expense of the severed connector, and securing that enlarged loop to the adjacent frame that extends around the periphery of a spring unit. That method, however, is not entirely satisfactory.

An aim of the present invention is to provide an alternative method of overcoming the problem outlined above.

The present invention consists in a method of making a spring unit comprising the steps of making a plurality of spring bands, each comprising a length

of wire bent so as to form a plurality of coil springs disposed side by side in a row, ends of the coil springs lying in or near opposed edge faces of the band, and a plurality of connectors integral with the springs, each such connector lying in or near an edge face of the band and serving to interconnect two adjacent springs in the row, and each connector having two spaced end portions extending transversely of the band with an intermediate portion between them, the intermediate portion extending past said two adjacent springs, forming a length of spring unit by disposing said spring bands side by side so that their edge faces lie in or near main faces of the length of spring unit and linking the spring bands together with a plurality of helical wires some lying in or near one of said main faces and others lying in or near the other of said main faces and each helical wire embracing component portions of each band, namely two adjacent end portions of two neighbouring connectors, and dividing the length of spring unit to leave a separate, individual spring unit, division being effected by omitting or removing a helical wire from one main face of the length of spring unit and severing through the middle of the adjacent connectors in the other main frame thereof, the method being characterised in that during the formation of each spring band, at least those connectors that are to be severed are so shaped that a central part thereof extends transversely of the band, the arrangement being such that when said central part is severed, each severed part includes sufficient wire to enable it to provide an attachment portion extending transversely of the unit in or near to the adjacent end face of the unit.

The attachment portions thus formed can be attached to a peripheral frame as described above.

The formation of the intermediate portion of each connector of each spring band in such a manner that it includes a part that extends transversely of the band, requires the use of more wire, per unit length of spring band, than would be required if the connectors merely extended longitudinally of the band as has been the case hitherto. It would be possible to arrange for the connectors having transversely extending central parts to be provided only at those places along the length of spring unit where the division is to occur. It is preferred, however, to form all the connectors alike with transversely extending central parts. The reason for this is that those transversely extending parts of the intermediate portions can be of value as they can extend into parts of the main faces of the unit that are otherwise unoccupied and can thus afford support for fabric and padding that may be used in the upholstery of the unit. The provision of transversely extending parts of the intermediate portions of the connectors to achieve this end is described and illustrated in the specification of British patent No. 2 143 731 of Multilastic Limited and will not be further described herein. The formation of such transversely extending parts can readily be effected by first making spring bands as described in the complete specification of the aforementioned British patent No. 937 644 and then deforming each connector between complementary shaping dies.

The transversely extending parts of the connectors may be so shaped that when severed in the middle they leave part-connectors a shape such that they can provide attachment portions, without the need for additional deformation. A preferred method, however, is characterised in that, after formation of the length of each spring unit, each of said central parts of the connectors that are to be severed, is reshaped so as to provide an attachment portion closely adjacent to each side of the point of severance and substantially at right angles to the longitudinal axis of the spring band of which it forms a part.

Preferably each transversely extending part is initially approximately in the shape of the two equal sides of an isosceles triangle, but with the apex blunted so that it extends lengthwise of the spring band of which it constitutes a part. If a transversely extending part of that shape is severed at the middle of the blunted apex, each resulting part-connector then has an inclined limb terminating in a short section which extends lengthwise of the band. In a preferred method, the inclined limb is bent so that part of it extends lengthwise of the band, and is aligned with the remainder of the intermediate portion of the connector, while the other part of it extends at right angles to the length of the band. It is this latter part that forms an attachment portion and can be attached to a peripheral frame by a strip of metal or by similar securing means. The short terminal section of the part-connector (i.e. half the blunt apex referred to) is preferably arranged to extend transversely to the attachment portion so that it serves as a stop and prevents the attachment portion being pulled endwise free of the strip of metal or other securing means. Each of the transversely extending parts that is to be severed is preferably bent or re-shaped, to its final form before it is severed. In a preferred arrangement it is re-shaped between relatively movable dies which also incorporate cutters for severing the connector at the final stage of the re-shaping operation.

From another aspect the present invention consists in apparatus for use in the manufacture of a spring unit, the spring unit being divided from a length of spring unit comprising an assembly of spring bands and helical wires, each spring band comprising a length of wire bent so as to form a plurality of coil springs disposed side by side in a row, ends of the coil springs lying in or near opposed edge faces of the band, and a plurality of connectors integral with the springs, each such connector lying in or near an edge face of the band and serving to interconnect two adjacent springs in the row, and each connector having two spaced end portions extending transversely of the band with an intermediate portion between them, the intermediate portion extending past said two adjacent springs, the spring bands being disposed side by side so that their edge faces lie in or near main faces of the length of spring unit, and a plurality of helical wires, some lying in or near of said main faces and others lying in or near the other of said main faces and each helical wire embracing component portions of each band, namely two adjacent end portions of two

neighbouring connectors, the apparatus being characterised in that it comprises a plurality of bending and severing devices arranged in a row, each such device comprising relatively movable dies operative in a reshaping operation to reshape a central part of a connector in any associated one of the bands, the central part having been so shaped that it extends transversely of the band, and severing means operable in a severing operation to sever that reshaped central part, the arrangement being such that when said central part has been severed affords an attachment portion closely adjacent to each side of the point of severance.

The apparatus may be further characterised in that said relatively movable dies comprise a concave die and a convex die which, during the reshaping operation, enters the concave die, the convex die being at least in part constituted by a cutting tool which cooperates with a complementary cutting tool in the concave die, the cutting tools constituting said severing means. That part of the convex die alongside said cutting tool may be resiliently mounted in such a manner as to be operative not to yield during the reshaping operation but to yield when engaged by said complementary cutting tool during the severing operation.

The apparatus may be further characterised in that it also includes guide means movable from a state in which it can guide a length of spring unit past the row of bending and severing devices, to another state in which it brings each of the connectors that are to be reshaped and severed into a position in which it can be reshaped and severed by an associated one of the devices.

In the accompanying drawings:-

Figure 1 is a perspective view of part of a spring band of the kind specified;

Figure 2 is a schematic plan view of a spring unit of the kind specified and incorporating spring bands of the kind shown in Figure 1;

Figure 3 is a plan view of a shaping device for use in forming a connector with a supporting structure;

Figure 4 is a side view of the shaping device shown in Figure 3;

Figure 5 is a front view of the shaping device shown in Figures 3 and 4;

Figure 6 is an end view of apparatus for dividing a length of spring unit;

Figure 7 is a front view of the apparatus shown in Figure 6, as viewed from the left of Figure 6, but with certain parts omitted for clarity;

Figure 8 is a plan view, to a much enlarged scale, of a device incorporated in the apparatus of Figures 6 and 7;

Figure 9 is an elevation of the device shown in Figure 8, but with supporting rails omitted for clarity;

Figure 10 is a section along the line 10-10 of Figure 8;

Figure 11 is a plan view of a connector constituting part of a spring band; and

Figure 12 is a plan view of the connector shown in Figure 11 but after it has been bent and severed by the device shown in Figures 8, 9 and 10

The spring band illustrated in Figure 1 is a spring band of the kind specified and comprises a length of wire bent so as to form a plurality of coil springs 1 disposed side by side in a row, ends of the coil springs lying near opposed edge faces of the band. In this particular form of spring band, alternate springs are coils of one hand while the remaining spring are coils of the other hand. In this way each left-handed coil is disposed between two right-handed coils, and each right-handed coil is disposed between two left-handed coils. This arrangement, however, is not an essential feature of spring bands used in connection with the present invention. The length of wire also affords a plurality of connectors 2 that are integral with the coils 1. Each connector lies at or near an edge face of the band and serves to connect two adjacent springs in the row. Each connector 2 extends past those two springs and has two spaced end portions 3 with a intermediate portion 4 between them.

After the springs have been formed, a turn of each spring is passed round a turn of the next adjacent spring so that each spring becomes linked to its neighbouring two springs. This interlinking of the springs is already known in spring bands of this kind.

A spring band of the kind described can be made by a spring-making machine of the kind described and illustrated in the complete specification of the aforementioned British patent specification No. 937 644.

After a spring band of that kind has been made, the band incorporating rectilinear connectors of rather greater length than usual, each connector in turn is introduced between appropriately shaped dies which are then closed to bend a central part of the intermediate portion to form a transversely extending part that constitutes a supporting structure support 5 of a kind that is the subject of the aforementioned British patent No. 2 143 731.

The partially formed spring band issuing from the spring-making machine passes onto a support (not shown) made of flexible sheet material and then passes from the support onto a table where the coils are successively linked together. This may be effected manually but is preferably effected mechanically. The linked coils then pass into a channel (not shown) with a flat base and vertical side walls. The coils are disposed with their axes in a common horizontal plane and the partially formed connectors 9 lying vertically against the side walls of the channel. The intermediate portions of the connectors lie in the bottom corners of the channel, where the side walls meet the base thereof.

The partially formed spring band is moved forward intermittently along the channel by feed means (not shown). The feed means comprises teeth which project into the channel through longitudinally extending slots in the side walls of the channel. The teeth are caused to reciprocate lengthwise of the channel. On their forward movement their leading faces engage end portions of connectors and push the spring band forwards. On reverse movement of the teeth, their inclined trailing faces of the teeth

slide past the spring bands without pulling the bands back again.

At the end of the second forward stroke of the feed device on each side of the channel, a partially formed connector is in a position immediately adjacent to a shaping device of the kind shown in Figures 3 to 5. One such device is mounted outside each of the side walls of the channel, while the base of the channel in front of each device is cut away to allow parts of the device to rise through the base as described below.

The shaping device illustrated comprises fixed components 21 to which a bar 22 is pivotally mounted by means of a horizontal pivot pin 23 parallel with the walls of the channel. The bar can be pivoted between an initial position, as illustrated, in which it is inclined to the horizontal and a final position, in which it is horizontal, by means of a pneumatic piston-and-cylinder unit 25. The upper end of the piston rod 24 of the unit 25 is pivoted at 26 to one end of the bar 22. One end of a link 27 is pivoted at 28 to the bar 22, and the other end of the link 27 is pivoted at 29 to a carriage 30 slidably mounted on the fixed components 21. When the bar is moved from its initial position to its final position, the carriage moves from a retracted position, as illustrated, in which it is flush with the adjacent side wall of the channel, to a working position, in which a forward part thereof projects into the channel.

The forward part of the carriage 30 includes two arcuate quadrant-shaped dies 31 presenting convex surfaces corresponding in shape to the corner portions of a completed or fully-formed connector 2. Between the dies 31, the forward part of the carriage includes a die 32, substantially in the shape of an inverted letter V, corresponding in shape to the supporting structure 5. A cylindrical rod 33 is also mounted on the forward part of the carriage 30 and can slide vertically in axially aligned holes formed in an upper part of the dies 32, in a plate 34 constituting part of the carriage, and in an upper limb of a bracket 35 mounted on the plate 34. The rod 33 carries a block 36 which can abut the plate 34 to limit its downward movement. A helical compression spring 37 around the rod acts between the block 36 and said upper limb of the bracket 35 to urge the rod downwards. Bolts 38 extend through the plate 34 and a small block 39 into the main body 40 of the carriage 30, the block 39 running in a slot in one of the fixed components 21.

At its forward end the bar 22 carries a die block assembly 41 formed with two, horizontally spaced, arcuate dies 42 of concave form complementary to that of the dies 31. The die block assembly 41 is also formed centrally with an upwardly projecting die 43 of a shape complementary to that of the die 32. A pair of arms 44 project upwards, one on either side of the die 43, the arms being less thick than the die.

One of the fixed components 21 carries an angled bracket 45 to which is secured the cylinder of a pneumatic piston-and-cylinder unit 46. The piston rod 47 of the unit 46 projects horizontally towards the channel and carries at its forward end a block 48 with a flat face 49 having projecting from it a vertical stop 50 constituting retractable stop means.

In use, after the feed means has pushed the spring band forwards, the piston-and-cylinder unit 46 is operated so as to cause the stop 50 to move to an active position in which it projects into the channel. At the end of that second stroke a partially formed connector, having the reference numeral 10, is disposed immediately adjacent to the shaping device illustrated. The forward end portion of the connector abuts the stop 50 while the rear connector abuts the leading face 19 of one of the teeth 18 of the feed means. The partially formed connector is thus located against movement to or fro along the channel.

Before feed means withdraws, the piston-and-cylinder unit 25 is operated to move the bar 22 from its initial position (illustrated) to its final position. As this occurs the carriage 30 moves its retracted position to its working position. During early stages in the movement of the bar 22 the top of the upwardly projecting die 43 engages a central part of the intermediate portion of the partially formed connector 10 and presses it against the lower end of the rod 33. Further movement of the bar 22 causes the die 43 to force the wire upwards into the die 32, while the fact that the central part thereof is trapped between the die 43 and the rod 33 prevents any tendency there might otherwise be for the wire to move endwise relative to the dies. Moreover, the arms 44 prevent the intermediate portion of the connector escaping by moving in a direction towards the middle of the channel. The dies 43 and 32 thus operate to shape the partially formed connector so that a supporting structure 5 is formed.

During this part of the movement the end portions of the partially formed connector are drawn towards each other and away from the stop 50 and the tooth 18. The stop and the tooth are then withdrawn

During the final stages of movement of the bar 22 to its final position the dies 43 and 32 together complete the shaping of the supporting structure 5. As this occurs, the arcuate dies 31 and 42 finally co-operate to rebend or reshape the end portions 10 so that their relatively sharp curves are opened out to form corner portions of more gentle curvature. This action serves to set accurately the distance between the end portions 3 of the finished connector.

The piston-and-cylinder unit 25 is then operated, causing the die block assembly 41, with the arms 44, to return to a position below the level of the bottom of the channel and causes the carriage to return to its retracted position. The spring band is thus free to be moved forward again by the feed means.

Spring bands of the kind illustrated in Figure 1 are assembled together to form a spring unit of the kind illustrated schematically in Figure 2. The spring unit is of the kind specified and comprises spring bands disposed side by side with their edge faces lying in or near the main planes of the unit, and a plurality of helical wires. Some of the helical wires 6A lie in or near one main plane of the unit, while other helical wires 6B lie in or near the other main plane thereof. Each helical wire embraces component portions of each spring band, namely two adjacent end portions 3 of two neighbouring connectors.

Each of the two marginal spring bands 7 and 8 of the unit is so orientated that its component connectors 2 lie at or close to the sides of the unit, while the remaining spring bands, 9, are all orientated in the same way as the marginal band 7. The connectors of the marginal bands 7 and 8 are at or close to the sides of the unit and are therefore suitably placed for attachment to peripheral frames lying in or near the main planes of the unit. The frames serve to strengthen the marginal parts of the unit and are made from flexible and resilient strip metal. Part of an upper peripheral frame 11 is shown in Figure 2.

The spring bands can be assembled with the aid of assembly apparatus of the kind described and illustrated in the complete specification of the aforementioned British patent No. 1 095 980. At uniform intervals one helical wire is omitted from the upper main face of the length of spring unit assembled by the assembly apparatus. As described in more detail below, it is at those places from which helical wires are omitted that the length of spring unit is subsequently divided to form individual spring units.

After leaving the assembly apparatus the length of spring unit is fed to apparatus for severing and dividing the length of spring unit into individual units each of predetermined length. The apparatus is illustrated in Figures 6 and 7. It comprises a stand 70 carrying guide plates 71 and 72 which are pivoted to the stand near their outer edges, As indicated at 73. Their inner edges can be raised and lowered by pneumatic piston-and-cylinder units 74. When the guide plates are in a raised position, as shown in Figure 6, linked bands resting on the guide plates can pass uninterrupted through the apparatus. When the guide plates are moved to a lower position, however, the linked bands engage bending and severing mechanism 75 which is disposed on the frame between the inner edges of the guide plates.

As described above, helical wires are omitted at regular intervals from the upper main surface of the length of spring band coming from the assembly apparatus. When the length of spring unit reaches a position in which that part of the unit from which a helical wire has been omitted is immediately above the bending and severing mechanism 75, the guide plates 71 and 72 are moved to their lower positions and the mechanism is operated to bend and sever the connectors which lie immediately beneath that part of the unit. The length of spring unit is thus divided, but the resultant parts are still interconnected owing to the interlinking of their springs. The parts can be separated manually, but it is preferred to unlink the springs on either side of the division by means of unlinking mechanism 76 which is operated by pneumatic piston-and-cylinder units 77. The unlinking mechanism 76 forms no part of the present invention and will not be further described herein. After the bending and severing mechanism 75 has operated and the divided parts are raised again, allowing the linked bands form the assembly apparatus to be fed forwards again. This continues until the next place from which a helical wire has been omitted is aligned with the mechanism 75, whereupon the process is repeated. Operation of the apparatus shown in Figures 6 and 7 may be carried out under manual control, but preferably it is carried out automatically in response to signals from the assembly apparatus.

The bending and severing mechanism 75 comprises a plurality of similar devices, one operative to bend and sever each of the bands. One of these devices, 78, is operative to bend and sever the marginal band 8 that is orientated in a manner different from that of the remaining bands. The other devices, 79, are operative to bend and sever those remaining bands. The device 78 has an operating lever 80 which is moved by a piston-and-cylinder unit 82, while each of the devices 79 has an associated operating lever 81. The levers 81 are pivoted to a common bar 83 of which one end is connected to a chain 84 which extends around a pulley wheel 85 and is connected to a piston-and-cylinder unit 86. Return movement of the bar 83 is effected by means of a piston-and-cylinder unit 87.

One of the devices 79 is shown in more detail in Figures 8, 9 and 10. Near its upper end, the operating lever 81 of that device is pivoted on a horizontal pivot bolt 88. End parts of the bolt extend through parallel slots, in the frame, between upper and lower supporting rails 89 and 90 respectively. A nut 91 on the bolt secures the bolt in the desired position of adjustment along the slots. A head 92 is secured to the upper end of the operating lever 81 by means of a screw 93. Integral extensions of the head form spaced abutments 94. A cutting tool 95 is secured in a slot in the head and projects between the abutments.

The bolt 88 also extends through a hole in a body 96 which includes a rib 115 which enters the adjacent slot between the rails and, in this way, locates the body against rotation. A tool carrier 97 is secured to the top of the body by means of a screw 98. A key 99 entering grooves in the body and tool carrier ensures accurate location of the tool carrier. The tool carrier extends above the operating lever 81 and spans the gap between the upper rails 89. A cutting tool 100 is mounted on the tool carrier 97 and co-operates with the tool 95 to sever a connector, as described below. A former 101 is mounted in a groove in the tool carrier 97 and lies alongside the cutting tool 100. An extension of the former 101 runs beneath a locating plate 102, which is secured to the tool carrier by screws 103. A resilient rubber block 104 is trapped at the end of the groove, beneath the locating plate 102, and is abutted by the adjacent end of the extension of the former.

Grooved mounting rails 105 are secured to the upper surfaces of the upper supporting rails 89, and upwardly tapering locating blocks 106 are secured to the mounting rails by screws 107.

Figure 11 shows a connector 108 of one of the bands of the spring unit. When the apparatus shown in Figures 6 and 7 is to be operated and the guide plates 71 and 72 are lowered, as described above, a connector of a shape exemplified by the connector 108 is lowered onto the device illustrated in Figures 8, 9 and 10 and takes up the position shown in chain-dotted lines in Figure 8. The tapered shape of

the locating blocks 106 ensures that the connector is lowered into the desired position, even if it was initially misplaced to some slight extent owing to the resilience of the band. When the operating lever 81 is moved, the head 92 approaches the tool carrier 97, and the abutments 94 engage side limbs 109 of the supporting structure of the connector. The apex of the supporting structure is forced into engagement with the tool 100 and former 101. Continued movement of the head 92 causes the limbs 109 to be reshaped so that they eventually assume the shape indicated in Figure 15: parts 111 of the limbs become aligned with outer parts 112 of the intermediate portion of the connector, and inner, attachment parts 113 of the limbs become bent at right angles to the parts 111. During the final stages of movement of the head 92, the cutting tool 95 co-operates with the cutting tool 100 to sever the connector at the blunted apex of the support as shown in Figure 12. As this occurs, the tool 95 forces the former 101 back from its normal position (illustrated), this being possible owing to the resilience of the rubber block 104 which is compressed by the extension of the former as the former moves.

After the connector has been severed, return movement of the operating lever 81 returns the head 92 to its initial position again, and the rubber block 104 returns the former 101 to its initial position.

When an individual spring unit has been detached from the length of spring unit by the apparatus shown in Figures 6 and 7, it is attached to peripheral frames like the frame 11 by means of strips of metal, each of which is wrapped round a frame and around an adjacent part of the spring unit. At the sides of the unit, the strips of metal are wrapped round the end portions of the connectors 4 of the marginal spring bands 7 and 8. At each end of the spring unit, one of the frames is attached to the unit by strips of metal which are wrapped round the frame and the adjacent end portions 3 of the last complete connector in each band of springs. The other frame is attached to the unit by strips of metal which are wrapped round the frame and around the adjacent inner parts 113 of the limbs of the severed connectors. This is illustrated somewhat diagrammatically in broken lines in Figure 12, where the upper part of the severed connector 108 is shown as being connected to part of a peripheral frame 116 by means of a length of metal strip 117 which is wrapped round the frame 116 and around the adjacent inner part 113 of the severed connector. A terminal portion of the severed connector extends tranversely to the part 113 and acts as a stop to prevent the part 113 sliding lengthwise out of the strip 117 and becoming detached from the frame.

Claims

1. A method of making a spring unit comprising the steps of making a plurality of spring bands (7, 8, 9), each comprising a length of wire bent so as to form a plurality of coil springs (1) disposed side by side in a row, ends of the coil springs lying in or near opposed edge faces of the band, and a plurality of connectors(2) integral with the springs, each such connector lying in or near an edge face of the band and serving to interconnect two adjacent springs in the row, and each connector having two spaced end portions (3) extending transversely of the band with an intermediate portion (4) between them, the intermediate portion extending past said two adjacent springs, forming a length of spring unit by disposing said spring bands side by side so that their edge faces lie in or near main faces of the length of spring unit and linking the spring bands together with a plurality of helical wires some (6A) lying in or near one of said main faces and others (6B) lying in or near the other of said main faces and each helical wire embracing component portions of each band, namely two adjacent end portions (3) of two neighbouring connectors, and dividing the length of spring unit to leave a separate, individual spring unit, division being effected by omitting or removing a helical wire from one main face of the length of spring unit and severing through the middle of the adjacent connectors in the other main frame thereof, the method being characterised in that during the formation of each spring band, at least those connectors that are to be severed are so shaped that a central part (109) thereof extends transversely of the band, the arrangement being such that when said central part is severed, each severed part includes sufficient wire to enable it to provide an attachment portion (113) extending transversely of the unit in or near to the adjacent end face of the unit.

2. A method according to claim 1 further characterised in that, after formation of the length of each spring unit, each of said central parts (109) of the connectors that are to be severed, is reshaped (111, 113, 114) so as to provide an attachment portion (113) closely adjacent to each side of the point of severance and substantially at right angles to the longitudinal axis of the spring band of which it forms a part.

3. A method according to claim 2 further characterised in that as a consequence of the reshaping there is formed a stop (114) between each attachment portion and the point of severance, the stop extending transversely to the attachment portion.

4. Apparatus for use in the manufacture of a spring unit, the spring unit being divided from a length of spring unit comprising an assembly of spring bands (7, 8, 9) and helical wires (6A, 6B), each spring band comprising a length of wire bent so as to form a plurality of coil springs (1) disposed side by side in a row, ends of the coil springs lying in or near opposed edge faces of the band, and a plurality of connectors (2) integral with the springs, each such connector lying in or near an edge face of the band and serving to interconnect two adjacent springs in the row, and each connector having two spaced

end portions (3) extending transversely of the band with an intermediate portion (4) between them, the intermediate portion extending past said two adjacent springs, the spring bands being disposed side by side so that their edge faces lie in or near main faces of the length of spring unit, and a plurality of helical wires, some (6A) lying in or near of said main faces and others (6B) lying in or near the other of said main faces and each helical wire embracing component portions of each band, namely two adjacent end portions of two neighbouring connectors; the apparatus being characterised in that it comprises a plurality of bending and severing devices (75) arranged in a row, each such device comprising relatively movable dies (92, and 100 and 101) operative in a reshaping operation to reshape a central part (109) of a connector in any associated one of the bands, the central part having been so shaped that it extends transversely of the band, and severing means (95, 100) operable in a severing operation to sever that reshaped central part (111, 113, 114), the arrangement being such that when said central part has been severed affords an attachment portion (113) closely adjacent to each side of the point of severance.

5. Apparatus according to claim 4 further characterised in that said relatively movable dies comprise a concave die (92) and a convex die (100, 101) which, during the reshaping operation, enters the concave die, the convex die being at least in part constituted by a cutting tool (100) which cooperates with a complementary cutting tool (95) in the concave die, the cutting tools constituting said severing means.

6. Apparatus according to claim 5 further characterised in that part (101) of the convex die alongside said cutting tool (100) is resiliently mounted (104) and is operative not to yield during the reshaping operation but to yield when engaged by said complementary cutting tool (95) during the severing operation.

7. Apparatus according to any one of claims 4 to 6 further characterised in that it also includes guide means (72) movable from a state in which it can guide a length of spring unit past the row of bending and severing devices, to another state in which it brings each of the connectors that are to be reshaped and severed into a position in which it can be reshaped and severed by an associated one of the devices.

8. A spring unit when made by apparatus according to any one of claims 4 to 7.

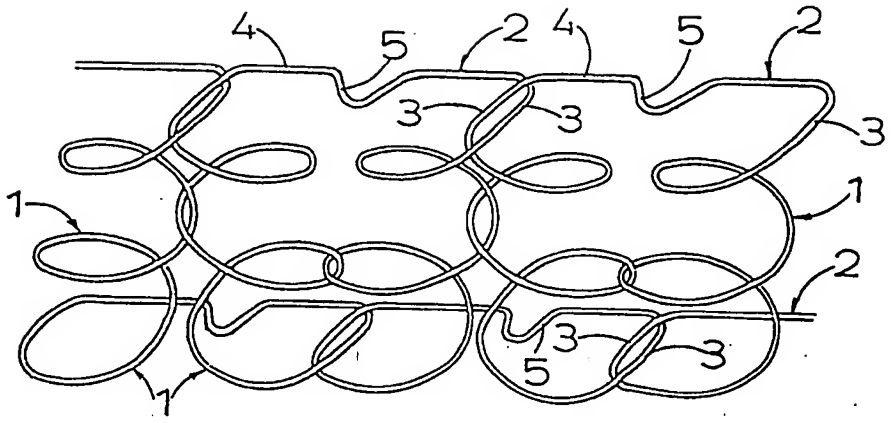

FIG.1.

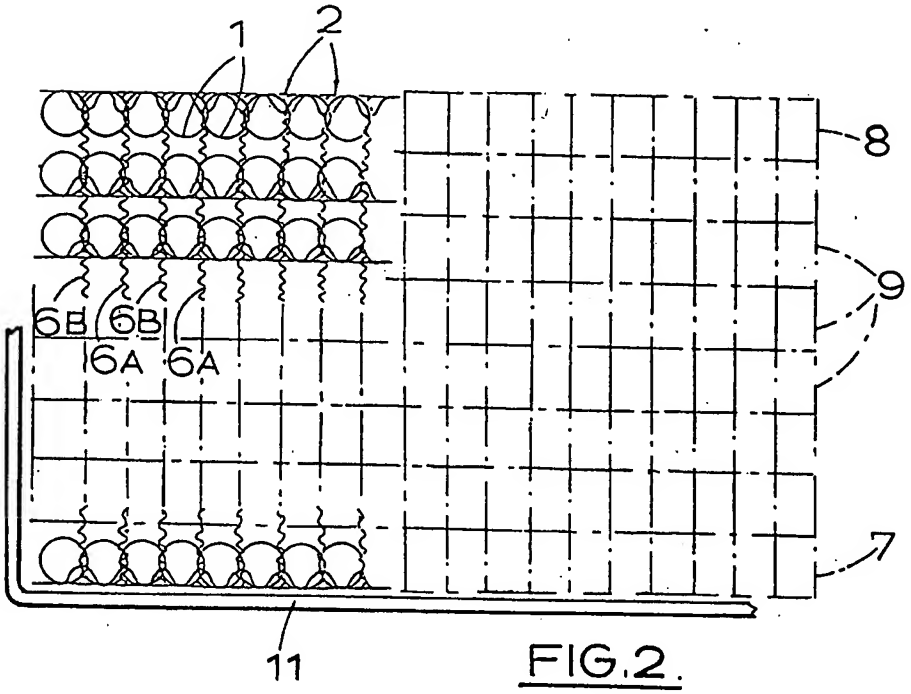

FIG.2.

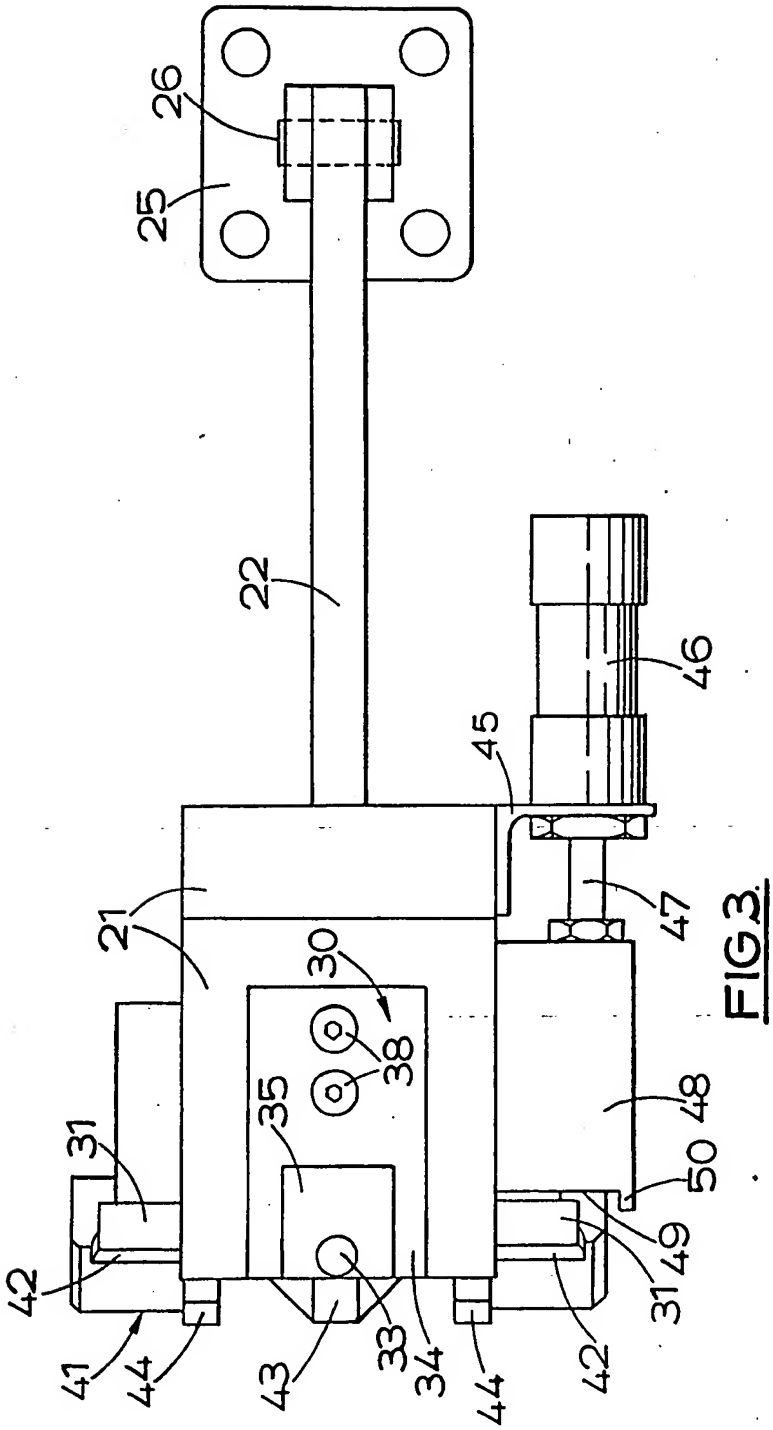

FIG.3.

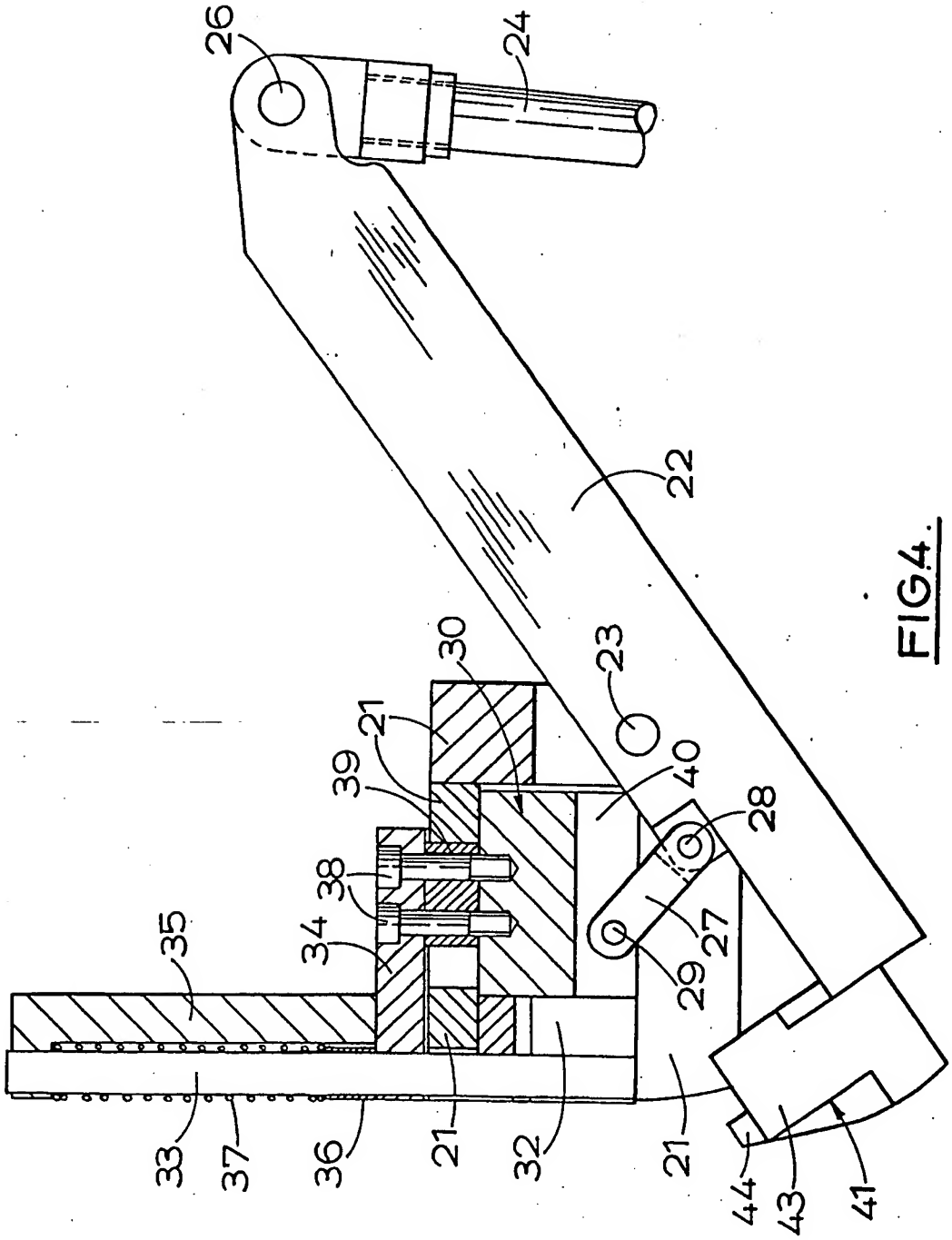

FIG4.

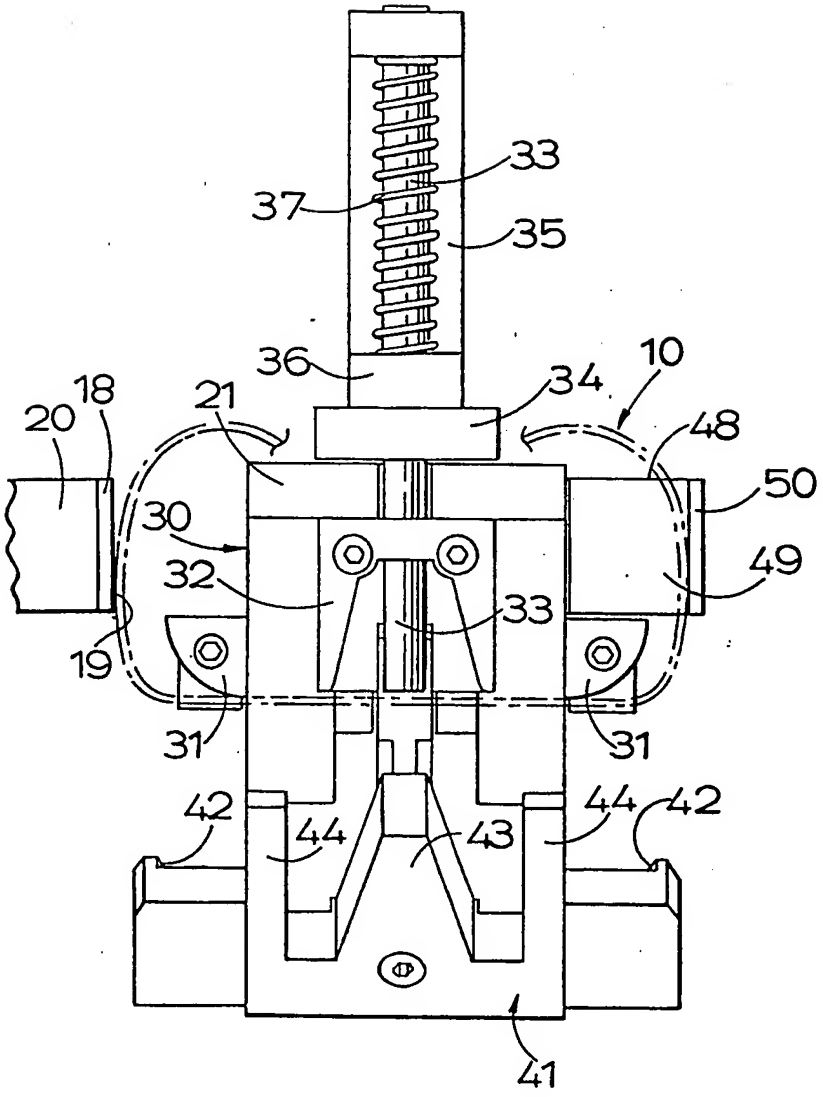

FIG.5.

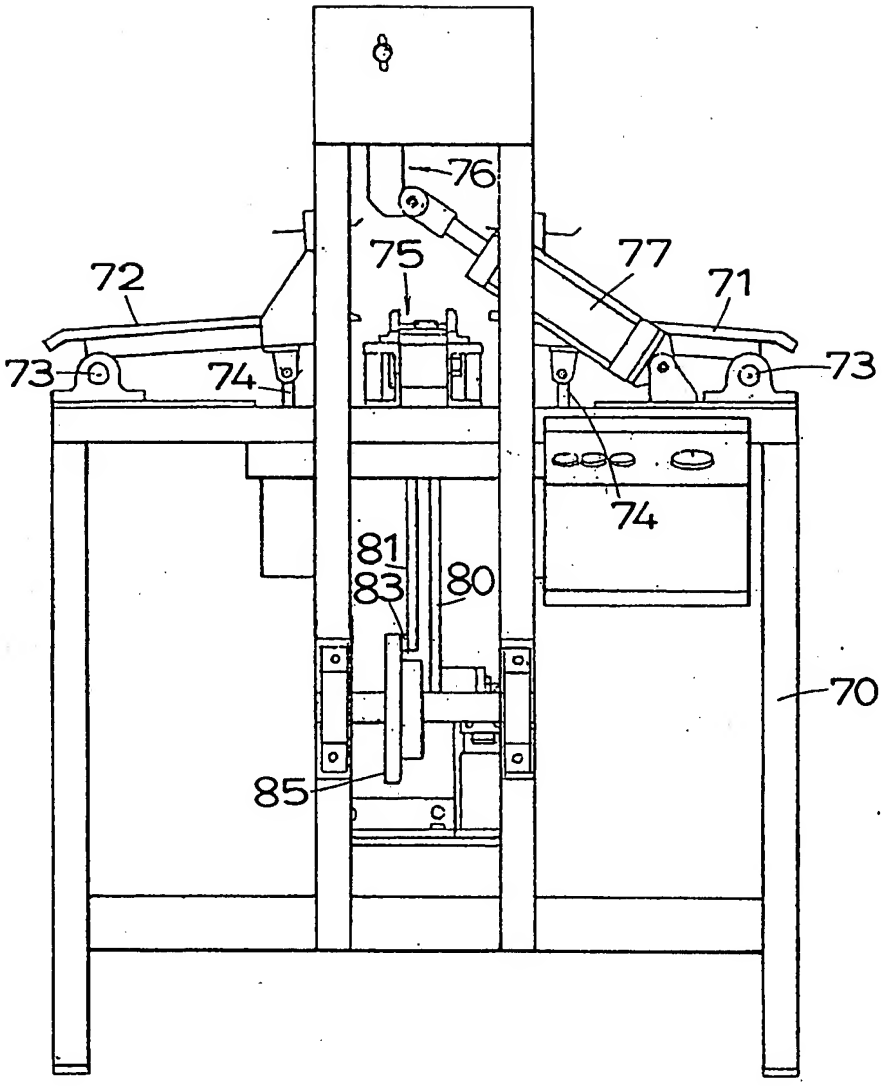

FIG.6.

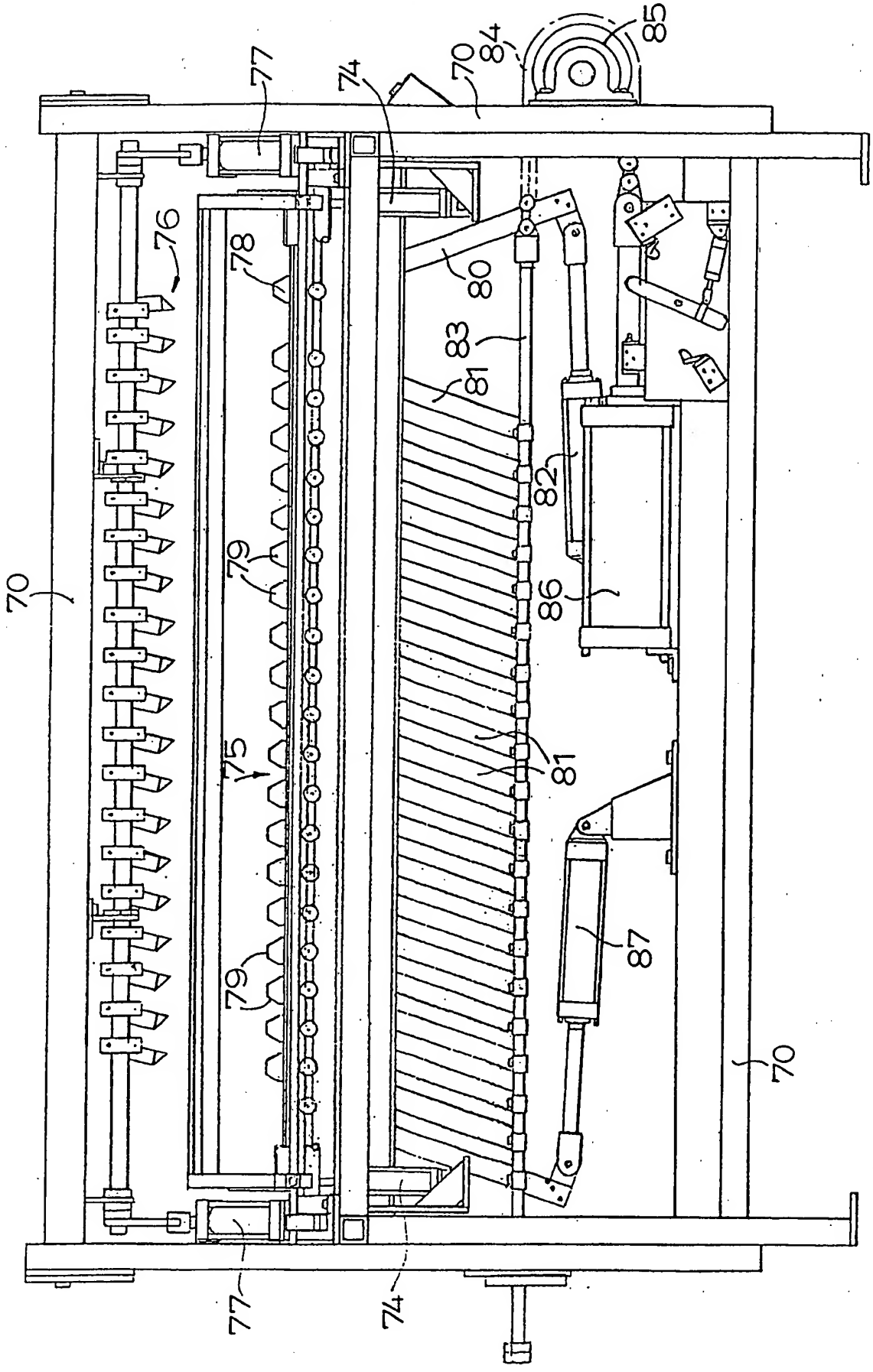

FIG. 7

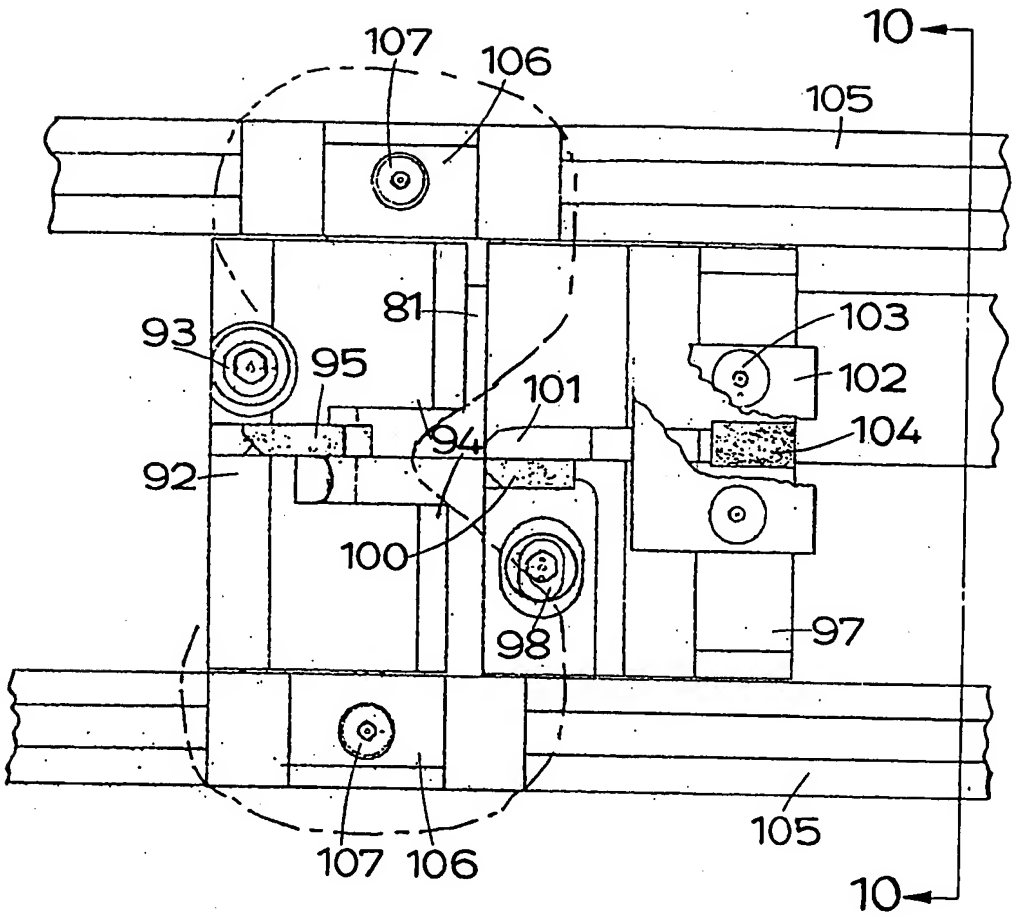
10
107
106
105
81
93
95
103
102
101
94
104
92
100
98
97
107
106
105
10

FIG.8.

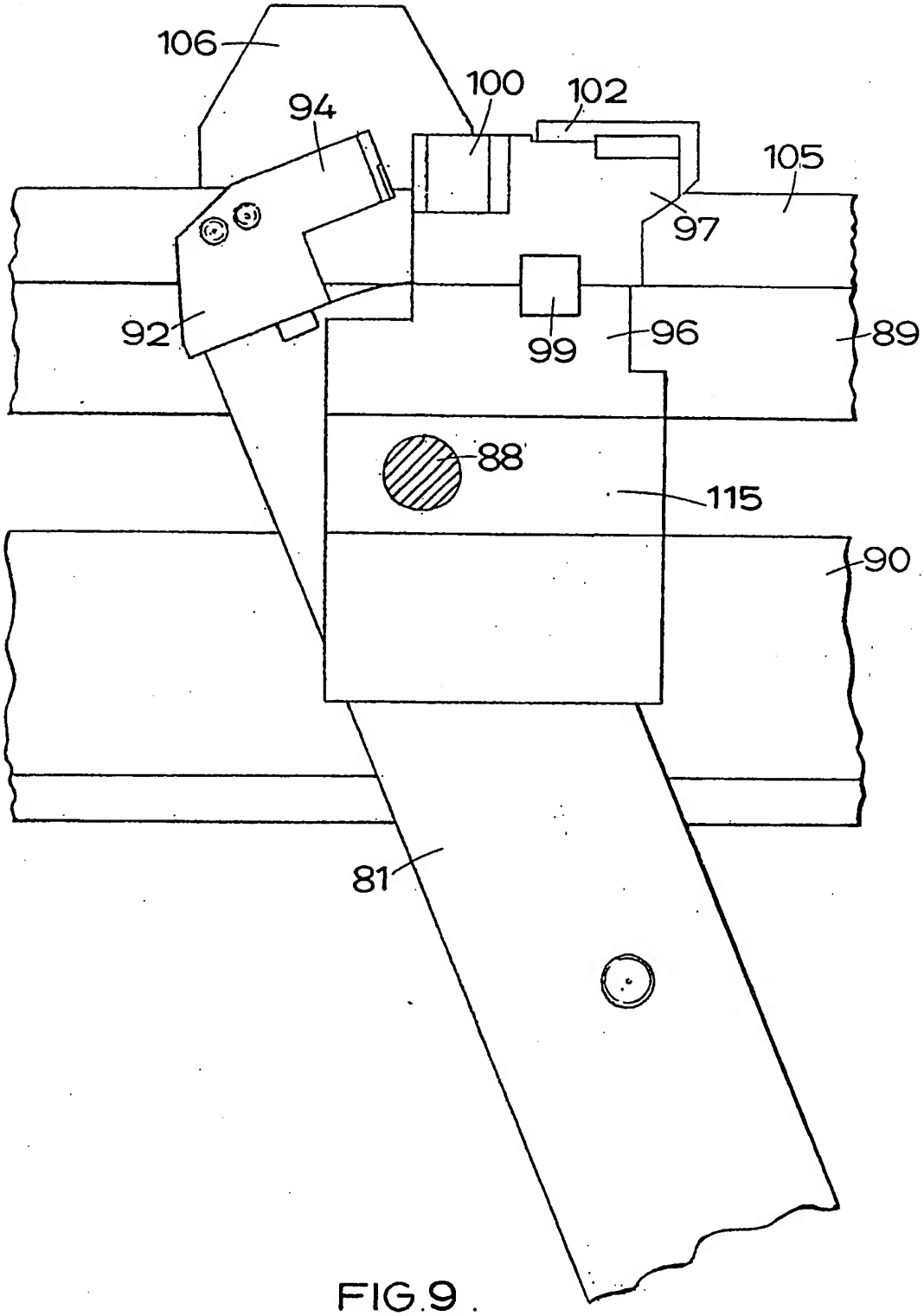

FIG.9

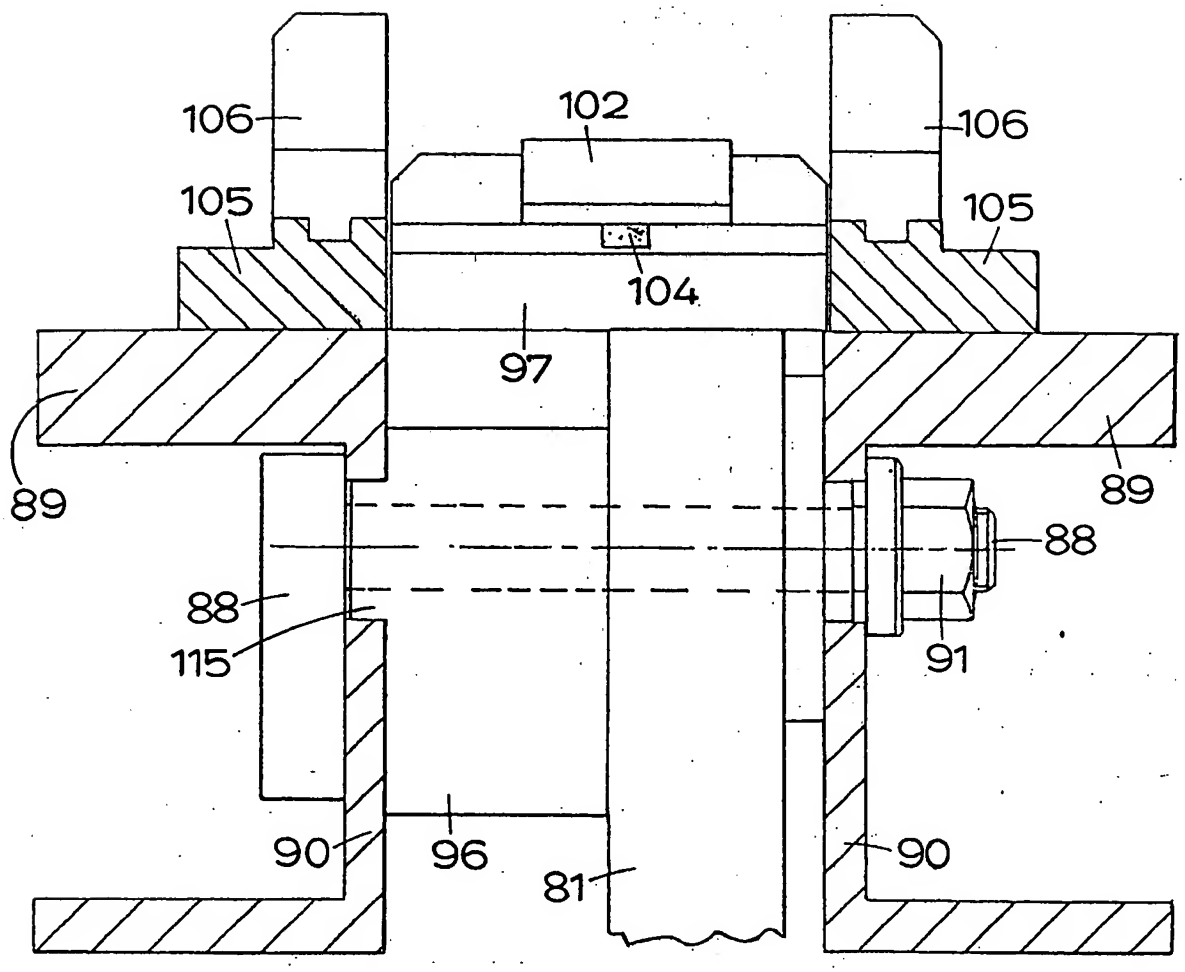

FIG.10

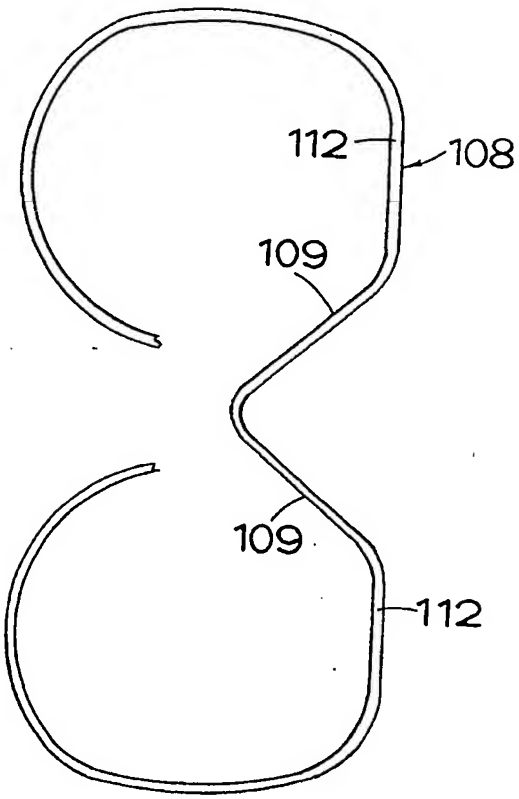

FIG.11.

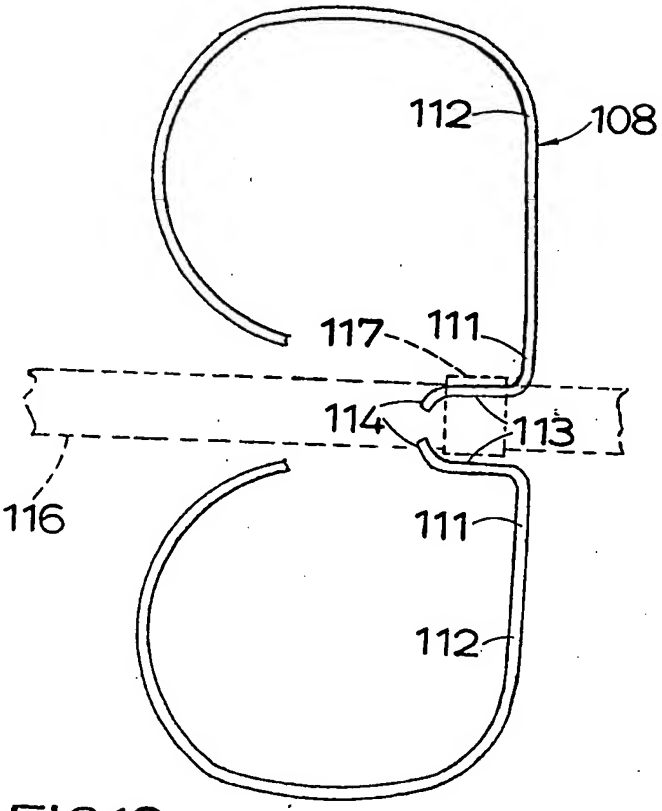

FIG.12

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 87 30 4933

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
D,A	GB-A-1 104 884 (MULTILASTIC) * figures 1, 5, 6; claims 1, 8 *	1	B 21 F 27/16
D,A	GB-A-1 095 980 (MULTILASTIC) * claim 1 *	1	
D,A	GB-A-2 143 731 (MULTILASTIC) * figure 1, claim 1 *	1	
D,A	GB-A-1 183 315 (MULTILASTIC) * figures 1, 4; claim 1 *	1	
D,A	GB-A-1 207 717 (MULTILASTIC) * claim 1 *	1	
D,A	GB-A- 937 644 (GERSTORFER) * figure 3, claim 1 *	1	TECHNICAL FIELDS SEARCHED (Int. Cl.4) B 21 F 27/00
A	DE-C-1 155 218 (GERSTORFER) * figures 1, 2; claims 1, 2 *	1	
A	US-A-3 476 156 (SIMONS) * figures 7, 8; claim 1 *	1	
A	DE-B-2 030 793 (SPÜHL) * figure 4 *	1	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	25-08-1987	SCHLAITZ J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503 03.82